



How the right investments in rainfed agriculture can stave off hunger in Africa.



Claudia Sadoff raises awareness of the role that water can play in tackling climate change.

STOCKHOLM

WATERFRONT

#3 | NOVEMBER | 2019

NEWS BRIEFS

Artificial rain forests, innovative tools, river surprises and more...



Landscapes as

CLIMATE SAVIOURS

Use water to tackle climate change!

A growing number of countries across the world are starting to understand that their futures depend on resilient landscapes. We need forests and wetlands to absorb carbon, protect biodiversity, recharge groundwater and reduce the impact from extreme weather.

At the same time, many decision-makers feel pressured to sacrifice wildland to let agriculture expand, since they must feed swelling populations and compensate for less productive soils. This could easily trigger a vicious cycle, with more and more land turned from carbon sinks to carbon sources.

It is, however, not an inescapable trap. All over the world, there are innovative initiatives that focus on the role of water in landscapes and how it can provide climate solutions. In this issue of *WaterFront* we look at some of them.

Starting on page 4, we analyze the barriers governments face when it comes to sustainable use of land and water, drawing on lessons from the Nairobi Water Fund in Kenya as well as work with a Blue Target Tool in Brazil. How rainfed agriculture can improve food security in Africa is explored on page 7.

To meet the leading resilience expert Claudia Sadoff, from the International Water Management Institute, turn to page 8. We also learn about how residents around Lake Hawassa in Ethiopia tackle the lake's pollution problems, on page 12. Lastly, on page 14, Mats Eriksson from SIWI explains why we should be paying much closer attention to what is happening to snow and ice in the world's coldest mountain regions.

Enjoy the read!



Solutions from resilient landscapes



New hope for Africa's farmers



Meet Claudia Sadoff



Saving Lake Hawassa



Lessons from glaciers



Torgny Holmgren
Executive Director,
SIWI



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Saving money with green infrastructure

The World Resources Institute has launched a new tool for cities to calculate the actual cost of investing in green infrastructure, such as forest and ecosystem restoration in source watersheds. The Green-Gray Assessment can be used to compare any combination of green, grey or hybrid solutions.



Glacial rivers absorb carbon faster than forests



Researchers in Canada's high Arctic have made a surprising discovery: the northern rivers here have pulled carbon dioxide from the atmosphere at a rate faster than the Amazon rainforest. The findings, published in Proceedings of the National Academy of Sciences, are unexpected since rivers have often been seen as a source of carbon emissions.

Deadly typhoons in Japan

After typhoon Hagibis caused widespread flooding in Japan in October, killing at least 80, experts are debating how the country can prepare for the increasingly powerful storms that follow from climate change. The levees built up over decades along virtually all of Japan's major rivers will not suffice, reports the magazine *Science*.

Lessons from droughts in rainforests

In a greenhouse in the Arizona desert, researchers are conducting the largest forest drought experiment ever. The greenhouse contains a small tropical rainforest and is sealed shut for six weeks, reports *Science*. The researchers hope to gain a new understanding of how prolonged droughts can impact rainforests.

Report calls for more research on agriculture



The recent report from the Global Commission on Adaptation clearly demonstrates the importance of major investments in the face of the climate crisis. For example, it calls for a doubling of the scale of agricultural research, with a focus on helping smallholder farms cope with extreme and unpredictable weather.



New tool for water and forests

FAO, the Food and Agriculture Organization of the United Nations, recently presented its Forest-Water Indicator Framework with indicators to measure forest-water relationships. A facilitation guide was launched in October and the full framework will be available in 2020, enabling technicians, practitioners and policymakers to improve their understanding of water ecosystems, water management and climate scenarios.



It's worse than you think

Two recent reports claim that the water crisis is underestimated. According to the World Resources Institute's *Unaffordable and Undrinkable: Rethinking Urban Water Access in the Global South*, nearly half the population in 15 major cities lack access to piped public water. The World Bank report *Quality Unknown: The Invisible Water Crisis* finds that human progress and economic growth are endangered by contaminated water. Recognizing the scope of the problem, identifying the magnitude of the impacts, and formulating ways to address these will be critical to improving public health, preserving ecosystems, and sustaining economic growth throughout the twenty-first century, the report says.



A growing body of research sheds new light on the role of landscapes. The picture is from pasture land in Kenya.

The lay of **the land**

Landscapes play a critical role in the climate system, as well as for food security, disaster risk reduction and biodiversity. Yet, many countries find it hard to translate this knowledge into concrete actions to reach their climate goals. A recent report from the Intergovernmental Panel on Climate Change discusses these barriers – and shows how they can be overcome.

Text | Maria Sköld **Photos:** iStock and private

Never before have humans consumed so much land and freshwater, and we are only now starting to understand the consequences. According to the recent *Climate Change and Land* assessment report from the Intergovernmental Panel on Climate Change (IPCC), human use affects more than 70 per cent of the global, ice-free land surface, which has led to growing net greenhouse gas emissions.

At the same time, the report shows how landscapes also serve as carbon sinks and that sustainable landscape management is a powerful tool to make societies more resilient to climate change. Countries are starting to realize that we are at a crossroads, where sustainable landscape management must be used for both mitigation and adaptation, while inaction may soon result in a vicious circle that will be hard to break.

In the worst-case scenarios, emissions from agriculture, forestry and other forms of land use will rise sharply (currently they account for around 23 per cent of human-induced emissions). A main driver could be increased demand for farmlands, as human populations grow rapidly while soils become increasingly degraded and less productive. A likely response would be to turn more forests and wetlands into cultivated land, meaning that they become carbon emission sources instead of carbon sinks. The result would be higher emissions of greenhouse gases, more soil erosion,

more unpredictable rainfalls, more droughts and floods.

In these scenarios, ecosystems are becoming increasingly fragile, with landscapes less able to provide food, freshwater, buffers and other vital ecosystem services. According to the Intergovernmental Science Policy Platform on Biodiversity and Ecosystem Services (IPBES) this could drive one million species to extinction and threaten human existence.

“We may be at a turning point, with more people becoming aware of the climate crisis and how it is linked to ecosystems”

Professor Anna Tengberg



“The situation is very serious. But we may be at a turning point, with more people becoming aware of the climate crisis and how it is linked to ecosystems.

I hope that governments will understand that sustainable landscape management must be at the heart of effective climate policy if we are to achieve the goals of the Paris Agreement,” says Professor Anna Tengberg from Lund University, Sweden, and Stockholm International Water Institute (SIWI).

As a contributing author to the IPCC report on *Climate Change and Land* she has looked at what keeps countries from

making the necessary changes. Lack of knowledge turns out to be an important barrier. At times, the right information is not available, for example about to what extent specific soils or forests are degraded. In other instances, different studies point in different directions – will for example 90 per cent of coastal wetlands disappear or will they in fact increase in size? It is also hard to predict how different factors influence each other and to foresee cascading effects.

Even when the scientific information is available, it can be so complex that decision-makers find it hard to understand and act upon. Many countries struggle to formulate policies, laws and regulations, while others have problems implementing them or following up to draw conclusions.

So, while all countries have a responsibility to do what they can to mainstream sustainable landscape management

into all areas of policymaking, Anna Tengberg stresses that the international community should provide support. For best-practice ideas to spread fast enough, countries and organizations must collaborate over funding, knowledge, research and networks. “We all benefit from swift action and we all pay a high price if we don’t act fast enough,” she says.

One complex and contentious topic is the relationship between trees, forests and water. Researchers agree that there are important interlinkages, but they still don’t fully understand exactly how trees and forests protect and regulate water. There is a need for more research, monitoring and evaluation of the ●●●



Up to two million trees will be planted by 20,000 farmers in Kenya to prevent erosion.

that produces 95 per cent of water for the Kenyan capital and 65 per cent of the country's hydropower. "The Nairobi Water Fund has been a triple-win initiative through its three goals, the 3Cs: Conserving nature, Clean water and Community benefits," explains the Water Fund's Director, Fredrick Kihara.

The Fund is working with over 20,000 small holder farmers in the watershed who are practicing agroforestry and planting up to two million trees to prevent erosion, which used to be a big problem in this area characterized by steep hills. As a result, Nairobi now receives cleaner water and the hydro-power plants can operate more efficiently when there is less sediment. Not least, the massive planting of trees, grass and plants is expected to result in the absorption of 320,000 tons of carbon, annually.

Local farmers have also received more immediate benefits. "The project has initiated rainwater harvesting by developing smallholder water pans for storage. This is helping to reduce over-abstraction of water during the dry season to support irrigation and an increase in food production," says Fredrick Kihara. ●

●●● effects of forest management and land use change for water yields and quality. But interest is growing, resulting in many new tools and methods that benefit the science community and practitioners alike.

found in tropical areas. We have many knowledge gaps and lack the calibration needed for making comparisons."

The adaptation of the Blue Targeting Tool is still a work in progress, but Aline Fransozi hopes that it will soon be used

"The biggest challenge is the high biodiversity and natural heterogeneity found in tropical areas"

Aline Fransozi

One example is the Blue Targeting Tool, first developed in Sweden back in 2011 but now used in many different contexts. Aline Fransozi, PhD student at the Forest Hydrology Laboratory of Sao Paulo University in Brazil, has worked on adapting it to tropical conditions. "The biggest challenge is the high biodiversity and natural heterogeneity



to close some of these knowledge gaps. "We believe that this tool, just like the original, will be used also outside of universities, by landowners, organizations and public institutions, to guide the management of degraded riparian areas," she says.

Another project that has been met with great interest is the Nairobi Water Fund. It started in 2015 with the aim to conserve the Upper Tana watershed

SOME KEY TERMS

- **Deforestation** = the conversion of forest to non-forest land, can result in land degradation.
- **Forest degradation** = land degradation which occurs in forest land.
- **Land degradation** = in the IPCC report defined as "a negative trend in land condition, caused by direct or indirect human-induced processes including anthropogenic climate change, expressed as long-term reduction or loss of at least one of the following: biological productivity, ecological integrity, or value to humans".
- **Soil erosion** = absolute soil losses in terms of topsoil and nutrients. Soil erosion is a natural process in mountainous areas but is often made much worse by poor land management practices (adapted from FAO).



Rooting for African farmers

In Africa, subsistence farmers must produce more food to avert a widespread hunger crisis in coming decades. The good news is that this is fully achievable, if sufficient investments are made in enhanced rainfed agriculture.

Text | Maria Sköld **Photo: iStock**

Already today, one third of Africans face food insecurity and in the coming decades the situation could become even more desperate, as the population in Africa is expected to soar from a little over one billion today to more than four billion by the year 2100. In parallel, climate change will make agriculture increasingly difficult, with more unpredictable rainfalls and a growing number of droughts and floods.

Green water is infiltrated rainfall water that is stored in the upper layers of the soil and available to plant roots. It is of special importance in Africa, which is the world's driest continent and where 95 per cent of the food production relies on small-scale rainfed agriculture.

"Food production among subsistence farmers in Africa has to increase. It is urgent to modernize the agriculture so that it gives food for the population,"

for green water solutions. In a recent film, the two agree that the situation is challenging, especially in Africa which is the continent facing the largest frequency of droughts, dry spells and floods.

"The solution is soil management so that the rain can enter the root zone and doesn't just run off. And to harvest rainfalls, to use for irrigation during the dry spells," Professor Falkenmark explains.

Much of the technology to do this exists but needs to be upscaled. Johan Rockström provides examples: "Small-scale dams collecting local run-offs that can be used in green-water management systems as supplementary irrigation. Systems of conservation tillage – you simply just open the soil and enable rainfall to infiltrate, creating green water in the soil, which gives more water to plants. You have soil and water conservation systems that are tremendously effective in terracing and locking the rainfall exactly where you want it in the farmer's field. So, the solutions are there."

The real problem, he argues, is a lack of investment in making these technologies available to farmers. A solution could be an investment fund supporting resilient agriculture.

"Now is the time to put the big investments where the bulk of the water is, and where the enormous untapped potential lies, which is innovations in green water," Professor Rockström says. ●

"The agriculture is very low-producing, because the roots don't get the water in the soil since they're damaged by dry spells"

Professor Malin Falkenmark



Photo: Peter Hamneberg

In light of this, agriculture needs to undergo a major shift, argues Professor Malin Falkenmark, Senior Advisor at Stockholm International Water Institute and Stockholm Resilience Centre. She has developed the concept of green water, which she believes holds the solution.

says Malin Falkenmark. "The agriculture is very low-producing, because the roots don't get the water in the soil since they're damaged by dry spells."



Photo: Niklas Björting

Professor Johan Rockström, from the Potsdam Institute for Climate Impact Research, is another advocate

“Focus on water for adaptive solutions”

Text | Maria Sköld Photos | Mikael Ullén and iStock

Claudia Sadoff is surprised by the lack of focus on water in the climate debate. As Director General of the International Water Management Institute, IWMI, she knows that there are numerous water-related solutions that could make a huge difference. But so far, they often tend to be forgotten.



Claudia Sadoff has dedicated her whole career to topics related to resilience and sustainable water management, both as a scholar and as a practitioner at institutions such as the World Bank. Now she heads IWMI, a non-profit research organization focusing on sustainable use of water and land in developing countries.

In her view, there have been important scientific advances in the past few years that lead to improved understanding of the role of water for the climate. With this knowledge, it is possible to move societies, agriculture and landscape management in a much more resilient direction, which could have an enormous impact from a climate perspective. There are also many inspiring examples, including from her home city Colombo in Sri Lanka, where IWMI is headquartered. But the potential is much greater and in this interview, Claudia Sadoff explains why water should be front and centre in the climate debate.

What do you see as most important for the world to focus on when it comes to dealing with the climate crisis?

It is time for us to focus on adaptation. Until now, the discourse around climate change has focused overwhelmingly on mitigation. While the way we management water links to mitigation, that mitigation is not saving us from the imperative to adapt. Last year’s IPCC Special Report: *Global Warming of 1.5°C* and this year’s report by the Global Commission on Adaptation (GCA) *Adapt Now* force us to face the fact that climate change will require massive efforts of adaptation. We need to meet the challenges of both mitigation and adaptation with urgency and resolve.

Is the role of water in relation to climate change sufficiently recognized? What kind of change would you like to see?

It is surprising just how little the role of water is recognized in relation to climate change. At the Climate Summit in New York in September we saw a big push to transform food production systems, to protect oceans and to stem biodiversity loss – but freshwater was rarely mentioned. The Paris Climate Agreement all but ignores water. This lack of focus on water is surprising because it is largely through water that most people will ‘experience’ climate change: through unpredictable rains, through droughts and floods, through the disruption this will bring to our food systems and our drinking water supplies and our connectivity.

Moreover, water is not just a central part of the problem – it is also a central focus for adaptive solutions. Human security from water-related disasters, food security, and sustainable livelihoods and ecosystems will all rest to some degree on our ability to manage water in the context of climate change. Yet, until recently, water has not featured as a major point of discussion in climate adaptation discussions.

What is most important to make societies more resilient to the effects of the climate crisis?

We need a suite of governance, information and investment solutions that support prediction, preparedness, response and inclusive remediation. First, we need to understand the likely impacts of climate change, and for that we need modelling and ●●●

“Human security from water-related disaster will all rest to some degree on our ability to manage water in the context of climate change”

Claudia Sadoff





After massive destruction from flooding in 2010, Colombo began rehabilitating wetlands that now provide flood control and many other benefits.



The wetland convention

The Ramsar Convention on Wetlands is an international treaty for the conservation and sustainable use of wetlands, named after the Iranian city of Ramsar where the convention was signed in 1971.

●●● assessment. Then we need to tackle the various effects of climate change – whether it be the delayed onset of the rains in the growing season, increased floods or droughts, or sea level intrusion, for example. We need to prepare for uncertainties and respond to what we cannot avoid, for example by building water storage, developing new information and water management technologies, and deploying financial risk management and insurance schemes.

But we also need to accept that there is no “silver bullet” – not even a suite of silver bullets – to combat climate change. Solutions will need to be flexible and contextualized and co-created with communities. And these solutions will need to be effectively communicated, deployed and scaled.

Which groups are particularly vulnerable to the effects of climate change?

The most vulnerable groups are of course those that rely directly on water for their livelihoods. Small-

holder farmers living off rainfed agriculture and facing increasingly unreliable rains are particularly at risk, as are those who are most exposed to the impacts of floods and droughts in areas where risks are heightened. In sub-Saharan Africa 95 per cent of agriculture is rainfed, and more than 80 per cent of farmland is managed by smallholders. In the Middle East and North Africa 75 per cent is rainfed. These are some of the hot spots that are facing the greatest climate change risks.

What role can nature-based solutions play to improve resilience?

Nature-based solutions are a double win, strengthening adaptation while at the same time supporting mitigation. Watersheds, wetlands and mangroves can all play important roles in moderating climate extremes. As nature-based climate change mitigation, ecosystem services are used to reduce greenhouse gas emissions, to conserve and, where possible, expand carbon sinks. For nature-based climate adaptation, the aim is to preserve ecosystems and the services they provide that help people cope with climate change by reducing the impact of anticipated negative effects like more intense rainfall, more frequent floods, heat waves and droughts. Both mitigation and adaptation approaches seek to increase the resilience of ecosystems and to stabilize the provisioning of important services like flood protection, soil fertility, air quality and carbon storage.

Can you tell us a little about the experiences from Colombo, the world's first capital to be accredited by the Ramsar convention as a Wetland City?

Colombo, the capital of Sri Lanka and the headquarters of IWMI, is a city built on wetlands. In fact, much of the city is constructed on “reclaimed” wetlands. With a population of 5.6 million, the Colombo Metropolitan region accounts for almost 50 per cent of the national GDP.

Urban flooding in 2010 caused severe disruption and resulted in losses in excess of \$50 million. Detailed hydrological studies indicated that wetlands stored significant amounts of water (up to 68 million m³), and that continued loss of wetlands would worsen the impacts of future flooding. As a result, the government developed a plan to conserve the wetlands and manage them primarily for flood control but also for a range of other co-benefits, including biodiversity, climate control and recreation/tourism.

A wetland management plan has been developed, and many wetlands are being rehabilitated and managed. In recognition of these achievements, in 2018 Colombo was awarded wetland city accreditation by the Ramsar Convention. Although 18 cities around the world were given this designation, Colombo is the only national capital to be awarded.

The Global Commission on Adaptation has described agriculture as a sector in need of massive adaptation in the face of growing populations, climate change, degraded soils etc. In your view, what kind of change is needed?

What we need urgently is sustainable agricultural intensification. Agriculture accounts for about 70 per cent of freshwater withdrawals globally, and over 90 per cent in many of the countries where IWMI works. Agriculture's historical share of water, however, is increasingly being diverted toward higher value urban uses and rapidly growing manufacturing and services sectors. We should all be concerned that our farmers are going to be asked to grow more food, with less water and with greater hydrological uncertainty.

At the same time, there is (appropriately) increasing resistance against water pollution and deforestation caused by agricultural land clearance. This means that farming systems will need to change radically. Growing scarcity and unpredictability mean that agricultural water productivity must be increased. We will need better rainfall predictions and ‘smart agriculture’ technologies. We will need to increase water storage in order to buffer against hydrological uncertainty – in reservoirs, aquifers and soils. We will also need to build more circular resource and waste systems; safely returning water to agriculture through wastewater recycling, and safely returning nutrients from human, animal and food wastes to our soils. We will need to do more with less, while sustaining the ecosystems and biodiversity that form the very foundation of our global agricultural systems. ●



CLAUDIA SADOFF

Lives in: Colombo, Sri Lanka

Works at: Director General of the International Water Management Institute, IWMI, a non-profit, scientific research organization focusing on the sustainable use of water and land resources in developing countries. IWMI is a CGIAR Research Center with offices in 13 countries and a global network of scientists operating in over 30 countries. IWMI leads the CGIAR Research Program on Water, Land and Ecosystems.

Career: Her long career includes being Global Lead for Water Security and Integrated Resource Management at the World Bank, Distinguished Visiting Scholar at Oxford University, Chair of the GWP/OECD Task Force on Water Security and Sustainable Growth, Economic Advisor to IUCN, Member of the World Economic Forum's Global Agenda Council on Water Security, Member of the Global Water Partnership Technical Committee and Fulbright scholar at the Thailand Development Research Institute.

“We should all be concerned that our farmers are going to be asked to grow more food, with less water and with greater hydrological uncertainty”

Claudia Sadoff



Lake Hawassa is well-known for its wildlife and biodiversity.

She is tackling pollution

Joyce Klu is something of a plastic detective. Together with her colleague Girum Bhari she is tracking all the plastic that is dumped into Ethiopia's Lake Hawassa. Their work is part of a novel approach to saving the lake which also involves combating soil erosion and pollution.

Text | Georgette Keane and Maria Sköld **Photos:** Georgette Keane

On the shore of Lake Hawassa, Joyce Klu is busy untangling a pile of fishing nets. At the same time, she's straightening out one more question mark about where all the lake's plastics come from. In this case, it turns out that illegal fishing plays an unexpected role: "When we went to visit the Biodiversity department, they gave us a new insight: many fishermen use illegal fishing nets and what do they do with them afterwards? Dump them in the lake. Since the nets are illegal, nobody wants to be seen with them," Joyce Klu explains.

She and her colleague Girum Bhari have been hired as consultants to quantify the amount of plastics that is generated in the city of Hawassa and identify where it comes from, how much of it that is being recycled, and to study the impact of the plastic litter.

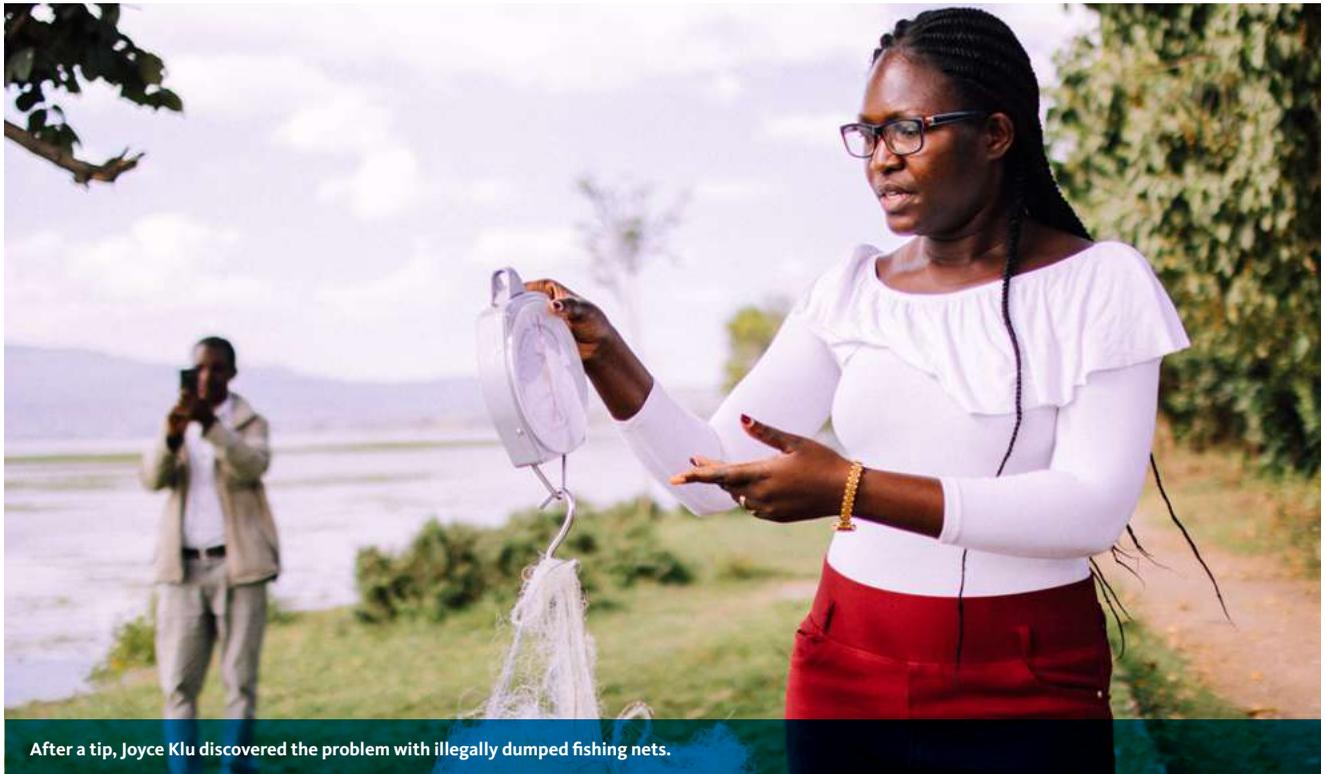
This is part of a larger project, carried out by SIWI with funding from Germany's Federal Ministry for Economic Cooperation and Development. Lake Hawassa will serve as a pilot project where the land-to-lake approach is implemented,

and it is followed with great interest by scientists and practitioners around the world.

Land-to-lake thinking – or source-to-sea, depending on the water's destination – concerns itself with all aspects of water body health, from key flows to sedimentation and wastewater treatment. And it involves everybody who has an impact on the lake, river or ocean in question, even those located far upstream.

As freshwater research has evolved, it has become increasingly clear that this approach is necessary to achieve results. Still, the concept is only now starting to gain traction, so more studies are needed to figure out how best to organize this type of collaboration between a great number of stakeholders.

Lake Hawassa was chosen for the pilot because it is small and does not have an outlet, meaning that it is impacted by what happens on land in much the same



After a tip, Joyce Klu discovered the problem with illegally dumped fishing nets.

in Lake Hawassa

way as a sea or an ocean would be. Due to its limited size it is possible to focus primarily on two major impacts: plastics and sedimentation.

Still, there are many drivers behind the deteriorating water quality of this the smallest of Ethiopia’s Major Rift Valley Lakes: the nearby city Hawassa is growing

“Many fishermen use illegal fishing nets and what do they do with them afterwards? Dump them in the lake. Since the nets are illegal, nobody wants to be seen with them”

Joyce Klu

very fast, there is an influx of tourists, industry is booming, and agriculture is often carried out in an unsustainable way. The area, which is known for its beauty and biodiversity, is becoming increasingly polluted and degraded.

Farming contributes in several ways – it requires water for irrigation, it leaks nutrients and chemicals, and it is both a cause and a victim of eroding soils. Dr Mulugeta Dadi is involved in finding solutions to the latter and he demonstrates a neat row of wooden poles erected through a gully created by erosion. The idea is that the structure will slow down water runoff when it rains and allow sediment to fill the area behind the poles.

Eventually it should be possible to plant grass and trees here to hold the soil in place and reverse the erosion trend. “We hope that the land will again be vegetated, green and useful to the community,” Mulugeta Dadi says. ●

From source to sea



- A source-to-sea or land-to-lake system connects water, biota, sediment, pollutants, materials and ecosystem services.
- It addresses the ways in which the impacts of altering them move up and downstream.
- A source-to-sea or land-to-lake approach involves up- and downstream stakeholders and supports coordination across sectors to address local challenges.

Learn more about how to implement the approach on page 15.

Water and Climate What's ice got to do with it?

Text | Mats Eriksson

With almost 70 per cent of the world's freshwater being locked up in the cryosphere, it is puzzling that what happens to snow, glaciers and ice-sheets in the light of climate change does not get more attention. However, things are improving, with growing awareness of how the melting ice and snow is impacting on ecosystems, societies, and communities worldwide, writes Mats Eriksson.

In the early 1990s, I was part of a small group of natural scientists at Stockholm University discussing the then recently published first report from the Intergovernmental Panel on Climate Change (IPCC). Much of the general public was still learning how to spell climate change. Among scientists, it was well accepted that glaciers provide one of the best indicators of climate change, but the debate often only centred around how much of those changes that were caused by humans.

Today we know better. Science has made great strides, with regular updates on the rapid, and accelerating, retreat of snow and ice around the world, and the subsequent impacts.

The latest IPCC report, focusing on *The Ocean and Cryosphere in a Changing Climate*, summarizes recent state-of-the-art insights into the topic. With the current alarming rate of global warming, where the mean sea level rise has reached 3,6 mm per year, it is important to highlight the link between the impact on the high-altitude cryosphere and what happens at sea level. The 680 million men, women, and children currently living in low-lying coastal zones around the world will reach more than one billion by 2050, 10 per cent of the world's population, and the battles they are fighting against storm surges, tidal waves, and saltwater intrusions will have grown from a whisper to a roar.

At the same time, a similar number of people who live in the mountainous regions that cover one quarter of the world's land surface, are facing increasing challenges related to the disappearing cryosphere. Many of them, who often belong to indigenous groups, are at risk of losing their agricultural yields, animals, homes, livelihoods, and possibly their own or their children's lives, despite having contributed little to climate change.

While we will be unable to reverse the current rapid retreat of glaciers – glaciers react to changes to the climate with an in-built reaction time of decades – we can reduce the related risks. As glaciers retreat, particularly in the high mountains of the Andes and Hindu Kush Himalayas, glacial lakes and water

bodies can form behind moraine ridges or in contact with the retreating ice. Occasionally the way they drain, causes catastrophic destruction of infrastructure, homesteads, livelihoods, and the loss of human lives.



One of my personal “awakening moments” relating to climate change was in the mountains of Chitral in North West Pakistan, close to the border of Afghanistan. I was sitting on the floor of a temporary hut with a family who had lost everything in a glacially derived flash flood. Now they were residing in a temporary shelter together with 106 other families, who had also lost their homes. How to recover and rebuild their lives was the topic of our conversation and suicide was quietly mentioned as a way out of the despair.

The family I spoke to were trans-continental victims of climate change, since the global warming causing the devastating flash flood is primarily a result of the lifestyles in the Western World. For me, meeting this family put a face on the impact of climate change and the expression “climate justice”.

People who have just had their lives shattered in a mountainwater hazard are also at risk of being recruited by terrorist groups, not least in areas such as the border between Pakistan and Afghanistan, while others join the migration stream from east to west. Further to the east, in the Nepalese Himalayas, similar water hazards will result in an increase in trafficking of young women and girls as families which have lost everything fall victim to traffickers who prey on their vulnerable circumstances. Thus, there is a clear security dimension to climate change which may have cascading impacts on several scales; from individual, to national, to regional, and intercontinental.

To combat the risks related to the global recession of the cryosphere, we need to not only mitigate greenhouse gas emissions, but also to closely monitor the changes to the cryosphere. This way we can assess and address the impact of the changes, in mountain regions as well as coastal zones. ●

ABOUT THE AUTHOR

Mats Eriksson is a Senior Manager for Transboundary Water Management at SIWI. He has a PhD in Geography and has published more than 30 scientific papers.

21–22 NOVEMBER

East Africa Water Summit

Gathering for the fourth time, the East Africa summit will meet in Nairobi, Kenya, to discuss “Sustainable Water and Sanitation in the Face of Climate Change”.

<http://www.eawaters.com/>



28–30 NOVEMBER

International River Summit

“Building a Resilient and Sustainable Future through Water” is the theme at this river summit organized in Prayagraj, India.

<https://rwua.org.in/Internationalriversummit2019/venue.html#>



1–5 DECEMBER

The Water and Development Congress

Sustainable solutions for emerging economies will be in focus at this conference in Colombo, Sri Lanka.

<https://www.waterdevelopmentcongress.org/>

2-13 DECEMBER

UN Climate Change Conference COP 25

The 25th Conference of the Parties to the United Nations Framework Convention on Climate Change will meet in Madrid, Spain, to speed up efforts to achieve the goals set in the 2015 Paris Agreement.

<https://unfccc.int/cop25>

All publications can be found online at www.siwi.org/publications

Source-to-sea guidance

To learn more about the Source-to-sea approach applied in the Lake Hawassa basin (p 12), check out SIWI’s report *Preventing Plastic Leakage from River Basins* and the policy brief *Source-to-Sea Framework for Marine Litter Prevention*. Concrete tips can be found in the *Implementing the Source-to-Sea Approach: A Guide for Practitioners*.

Read our latest publications!



Working with landscapes

SIWI also offers several publications on the topic of water, agriculture and landscapes (p 4–7), for example the reports *Mapping Financial Mechanisms for Enhanced Rainfed Agriculture in Africa* and *Water for productive and multifunctional landscapes*.

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